

Examining Learners' Emotional Responses to Virtual Pedagogical Agents' Tutoring Strategies

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1 Introduction

Given the preponderance of emotions in academic settings, particularly those related to achievement emotions [1] and the strides in both affect and affectively-embodied and sensitive virtual pedagogical agents (VPAs) [2], there has been a surge in research exploring the roles and possibilities that VPAs can play in facilitating learners' experience of positive emotions. This paper contributes to this ever-growing body of work by laying out recommendations for VPA tutorial strategies. In this study, we measured basic, universal, and discrete emotions identified by Ekman and Friesen [3]: happiness, sadness, anger, surprise, disgust and fear, in addition to neutral. These emotions can also be conceptualized into a valence dichotomy, where happiness is positively-valenced, surprise and neutral are non-valenced and the rest are negatively-valenced emotions. The second theoretical lens we used was Pekrun's Control-Value Theory of Achievement Emotions [1], which postulates that students' sense of control and attribution of value toward the achievement activity will influence their emotions and subsequently their learning outcomes.

In this study we examined the impact of two tutorial approaches on students' embodiment of discrete, basic emotions. These approaches were deployed in two separate conditions: (1) a prompt only (PO) condition, where the VPA prompted students to set three sub-goals, be mindful of their overall learning goal and either accepted or rejected students' proposed sub-goals and (2) a feedback (FB) condition, in which participants were additionally given information related to the relevancy and proximity of their proposed sub-goal to one or more of the seven ideal sub-goals. Our research question for this study was to determine what the proportional embodiment of discrete and valenced emotional states was during the sub-goal setting portion of participants' learning episode with MetaTutor, a multi-agent adaptive hypermedia learning environment for science learning [4]. We hypothesized, due to the lower affordance of control in the PO condition and achievement task-specific value being held constant across both conditions, that students would embody a greater proportion of negatively-valenced emotions in the PO than the FB condition.

2 Methodology

Participants included 18 undergraduate students (78% female) from 2 large public universities in North America. Participants were randomly assigned to one of three experimental conditions, where, for the purposes of this study, they interacted with a VPA which deployed one of the two aforementioned tutorial approaches for the goal-setting phase of the learning session with MetaTutor. In this study we used *FaceReader*TM 3.1, a software program developed by Noldus that analyzes participants' facial expressions, using an artificial neural network and thousands of models of faces and facial expressions to identify meaningful configurations of facial action units. The configuration of these facial action units, which are based on Ekman and Friesen's FACS system [3], is used to draw theoretically based inferences about the emotional states of participants.

3 Results and Conclusions

We performed two 2x3 Factorial Repeated Measures MANOVAs, one for each of the sets of emotions (discrete and valenced). Our preliminary analysis revealed that the VPA's tutorial strategy exerted a significant main effect upon participants' negatively-valenced emotions ($F(1,16) = 8.10, p < .05$). Our analysis of the discrete emotions revealed that the VPA's tutorial strategy exerted a significant main effect upon participants' embodiment of anger during the goal-setting episode ($F(1,16) = 5.21, p < .05$). Taken together, these results provide preliminary support for the existence of significant differences in the emotions participants embody at both the valenced and discrete emotional level in response to different VPA tutorial strategies. This study contributes to the development and design of affectively-competent VPAs by highlighting the importance and influence of meaningful and contextualized feedback on students' emotions. More broadly, these results demonstrate the importance of evaluating VPA tutorial strategies.

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